

LEVEL G

G 1-20 : Review up to F

The review includes conversion between mixed numbers and improper fraction, reduction of fractions, conversion of decimals to fractions, four operations of fractions, and order of operations.

G 21-60 : Addition & Subtraction of Positive & Negative Numbers

When the signs are different

Ex. $+5 - 2 = +3$
 $-5 + 2 = -3$
 $+2 - 5 = -3$
 $-2 + 5 = +3$

When the signs are the same

Ex. $+2 + 5 = +7$
 $-2 - 5 = -7$

When the signs are **different**, observe carefully when to “borrow” before subtracting

Ex. $1\frac{2}{5} - 4\frac{3}{5} = -3\frac{1}{5}$
 $1\frac{3}{5} - 4\frac{2}{5} = 1\frac{3}{5} - 3\frac{7}{5} = -2\frac{4}{5}$

Ex. $\frac{1}{3} - 2\frac{1}{2} = \frac{2}{6} - 2\frac{3}{6} = -2\frac{1}{6}$
 $\frac{1}{2} - 2\frac{1}{3} = \frac{3}{6} - 2\frac{2}{6} = \frac{3}{6} - 1\frac{8}{6} = -1\frac{5}{6}$

Remember that

$+(+■) = +■$, $+(-■) = -■$
 $-(+■) = -■$, $-(-■) = +■$

The ‘+’ sign in the front should be omitted.

Ex. $+(-2) - (+4) = -2 - 4 = -6$
 $-(-2) + (+4) = 2 + 4 = 6$

Always calculate terms with the same sign first.

Ex. $+4 - 5 - 1 + 6 - 3 = 10 - 9 = 1$

Ex. $\frac{2}{11} - \frac{5}{11} + \frac{1}{11} - \frac{4}{11} = \frac{3}{11} - \frac{9}{11} = -\frac{6}{11}$

G 61-80 : Multiplication & Division of Positive & Negative Numbers

Ex. $(+2) \times (+4) = +8$ $(-2) \times (+4) = -8$
 $(+2) \times (-4) = -8$ $(-2) \times (-4) = +8$

Ex. $(+8) \div (+2) = 4$ $(-8) \div (+2) = -4$
 $(+8) \div (-2) = -4$ $(-8) \div (-2) = 4$

When multiplying/ dividing numbers, first count the number of ‘-’ signs. If there is

- ✓ an odd number of ‘-’ signs, the answer is ‘-’.
- ✓ an even number of ‘-’ signs, the answer is ‘+’.

Ex. $(-\frac{3}{5}) \times (-\frac{5}{8}) \times (-2\frac{1}{3}) = -\frac{\cancel{3}}{\cancel{5}} \times \frac{\cancel{5}}{8} \times \frac{7}{\cancel{3}} = -\frac{7}{8}$
 $-(-2)(-3)(-4) = +2 \times 3 \times 4 = 24$
 $(-3)^3 = (-3)(-3)(-3) = -27$

Ex. $(-4) \times (-6) \div [(-3) \times (+16)] = -24 \div 48 = -\frac{1}{2}$
 $[(-3) \div (-8)] \div [(-9) \div (-4)] = \frac{\cancel{3}}{\cancel{8}} \times \frac{\cancel{4}}{\cancel{9}} = \frac{1}{6}$

Always determine the sign first, and reduce

Ex. $(-2)^3 \times (-\frac{1}{2})^4 = -\frac{\cancel{2}}{\cancel{2}} \times \frac{\cancel{2}}{\cancel{2}} \times \frac{\cancel{2}}{\cancel{2}} \times \frac{1}{\cancel{2}} \times \frac{1}{\cancel{2}} \times \frac{1}{\cancel{2}} \times \frac{1}{\cancel{2}} = -\frac{1}{2}$
 You should reduce first.

G 81-100 : Four Operations with Positive & Negative Numbers

Follow the BODMAS rule for order of operations: Perform operations in brackets first (B), then order/exponent (O), next division and multiplication (DM), finally addition and subtraction (AS).

Note: Add/subtract terms with the same sign first

Ex. $2 \times (-5) - 12 \div (-3) = -10 + 4 = -6$
 $(-14) - 4 \times (-12) \div (-6) = -14 - 8 = -22$
 $-2 - (-8) \div (-4) - (-9) = -2 - 2 + 9 = 5$
 $(-3)^2 \times (-4)^3 \div (-6)^3 = \frac{3 \cdot 3 \cdot 4 \cdot 4 \cdot 4}{6 \cdot 6 \cdot 6} = \frac{8}{3} = 2\frac{2}{3}$

How to simplify a complex fraction

Ex. $\frac{\frac{2}{3}}{\frac{4}{4}} = \frac{2}{3} \div 4 = \frac{2}{3} \times \frac{1}{4} = \frac{1}{6}$

$\frac{\frac{1}{2}}{-\frac{3}{4}} = \frac{1}{2} \div \left(-\frac{3}{4}\right) = -\frac{1}{2} \times \frac{4}{3} = -\frac{2}{3}$

G 101-120 : Values of Algebraic Expressions

Find the value of each expression when $a = -3$.

$$2a + 4 = 2 \times (-3) + 4 = -2$$

$$\frac{a}{4} = \frac{-3}{4} = -\frac{3}{4}$$

$$2a^2 = 2 \times (-3)^2 = 2 \times 9 = 18$$

Find the value of each expression when $a = \frac{1}{2}$ and $b = -\frac{1}{6}$.

$$(a - b)^2 = \left[\frac{1}{2} - \left(-\frac{1}{6}\right)\right]^2 = \left[\frac{3}{6} + \frac{1}{6}\right]^2 = \left(\frac{2}{3}\right)^2 = \frac{4}{9}$$

Note: Recall the BODMAS rule.

G 121-160 : Simplifying Algebraic Expressions

Collect like terms. Rearrange terms in alphabetical order/ in descending powers of a variable.

$$3a + b + 5a + 2b = 8a + 3b$$

$$\frac{3}{4}a - \frac{5}{6}b - \frac{1}{9}b = \frac{3}{4}a - \frac{15}{18}b - \frac{2}{18}b = \frac{3}{4}a - \frac{17}{18}b$$

$$x^2 + 2x + 3 + 2x^2 + 4x - 5 = 3x^2 + 6x - 2$$

The distributive property

Ex. $(2x + 3) - (x - 4) = 2x + 3 - x + 4 = x + 7$

$(2x + 3) + (x - 4) = 2x + 3 + x - 4 = 3x - 1$

$$\begin{aligned} & (2x^2 - 3x - 5) - (-2x^2 + 2x - 5) \\ &= 2x^2 - 3x - 5 + 2x^2 - 2x + 5 \\ &= 4x^2 - 5x \end{aligned}$$

$$\begin{aligned} & (2x - 3y) - (x + 4y) + (-5x + 8y) \\ &= 2x - 3y - x - 4y - 5x + 8y \\ &= -4x + y \end{aligned}$$

Ex. $3a - 2(4a - b) = 3a - 8a + 2b = -5a + 2b$

$3(3x - 1) - 2(x - 5) = 9x - 3 - 2x + 10 = 7x + 7$

Simplifying fractional expressions

Ex. $\frac{2x+3}{2} - \frac{x+7}{4} = \frac{2(2x+3) - (x+7)}{4} = \frac{4x+6-x-7}{4} = \frac{3x-1}{4}$

$\frac{x+1}{2} - \frac{x-1}{6} = \frac{3x+3-x+1}{6} = \frac{2x+4}{6} = \frac{x+2}{3}$ Reduce by 2

Ex. $\left(\frac{x+1}{2} + \frac{x-5}{3}\right) \times 6 = 3(x+1) + 2(x-5) = 5x - 7$

G 161-200 : Linear Equations

When solving linear equations, collect terms with the variable on the LHS and numbers on the RHS

Ex. $\frac{1}{2}x + \frac{1}{8} = \frac{1}{3}x + \frac{1}{4}$

[Sol] $\frac{1}{2}x - \frac{1}{3}x = \frac{1}{4} - \frac{1}{8}$

$\frac{1}{6}x = \frac{1}{8}$

$x = \frac{1}{8} \times \frac{6}{1} = \frac{3}{4}$

One efficient method is to multiply both sides of the linear equation by the LCM of the denominators

Ex. $\frac{2x-3}{4} - \frac{x-5}{6} = \frac{5}{12}$

[Sol] Multiply each side by 12.

$$3(2x-3) - 2(x-5) = 5$$

$$6x - 9 - 2x + 10 = 5$$

$$6x - 2x = 5 + 9 - 10$$

$$4x = 4$$

$$x = 1$$

Ex. $\frac{1}{2}(x-4) = \frac{1}{3} - \frac{1}{6}(x+2)$

[Sol] Multiply each side by 6.

$$3(x-4) = 2 - (x+2)$$

$$3x - 12 = 2 - x - 2$$

$$3x + x = 2 - 2 + 12$$

$$4x = 12$$

$$x = 3$$

When dealing with decimals, we can multiply the equation by 10 or 100 on both sides.

Ex. $2.4x + 0.7 = 1.8x + 2.5$

[Sol] Multiply each side by 10.

$$24x + 7 = 18x + 25$$

$$24x - 18x = 25 - 7$$

$$6x = 18$$

$$x = 3$$